

**Remarks**

Examiner Venhl is thanked for the thorough Office Action.

**CLAIM REJECTIONS:**

**Rejection Of Claims 1, 5, 6, 8 and 10 Under 35 U.S.C. § 103(a) as being anticipated by Ye et al. al. '529 in view of Yet et al. '516**

The rejection of claims 1, 5, 6, 8 and 10 under 35 U.S.C. § 102(e) as being anticipated by Ye et al. '529 in view of Yet et al. '516 is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the following remarks.

**Amended claim 1 is non-obvious**

Claim 1, step c1, claims: "in a first step, etching said organic low k dielectric layer by applying a plasma power and flowing at least  $\text{NH}_3$  gas and flowing CO or  $\text{O}_2$  gasses."

The combination of Ye 529 and Ye 516 is improper. The reference do not suggest they be combined. The reference solve different problems.

Ye 529 and Ye 516 teach different and conflicting etch chemistries. Neither suggests they can be modified.

The Office Action dated, posits that Ye suggest this. However, Ye teaches away from the claim 1 step c1's  $\text{NH}_3$  and CO or  $\text{O}_2$  etch gas by teaching (1) (See Ye, col. 12, line 20-21) a  $\text{O}_2$  and  $\text{N}_2$  alpha FC layer etch. Secondly, Ye teaches (2) a (See Ye col. 22, lines 41-42, ) a  $\text{NH}_3$  only etch of FLARE TM low K layer. There is no suggestion to modify Ye's 2 separate etches/embodiments. Therefore Ye teaches away from amended claim 1 step C1.

The Office Action p. 3, cites Ye 516 as teaching claim 1's etch using  $\text{NH}_3$  gas and CO or  $\text{O}_2$  gasses. However, Ye 516 teaches a etch using " $\text{O}_2$ ,  $\text{N}_2$ ,  $\text{NH}_3$ ,  $\text{Cl}_2$ , HCl or mixtures thereof by way of example and not by way of limitation". Col. 22, lines 14 – 16. Ye 516 does not teach the inventive concept of claim 1. Therefore it is not obvious for one skilled in

the art achieve claim 1 from the over thousand different combination possible from Ye 516.

There is no motivation of achieve claim 1 because no reference attempts to solve the applicant's problem of bowing via sidewalls. See spec. p 1., line 17; spec p. 4, lines 21 -24.p. 8, Lines 23 -26.

**Claims 5, 8 and 10 are non-obvious**

Claims 5, 8 and 10 are non-obvious over the cited art because they depend from non-obvious amended claim 1.

**Rejection of claim 4 Under 35 U.S.C. § 103(a)**

The rejection of claim 4 Under 35 U.S.C. § 103(a) is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the following remarks .

Claim 4 states:

4. (Amended) The method of claim 1 wherein said first step comprises applying a plasma power plasma density between  $1E9$  and  $1E11\text{ cm}^{-3}$  and flowing  $\text{NH}_3$  gas, a power in between 500 and 1500 W, and a  $\text{NH}_3$  flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing CO or  $\text{O}_2$  gasses.

Dependant Claim 4 contains specific result dependent parameters for the etch. These parameters are not suggested by the prior art. No other cited reference suggests that adding CO or  $\text{O}_2$  will reduce that polymer buildup and reduce sidewall bowing. See spec. p. 8, section D. Also, Claim 4 specifies a "medium plasma power" that is not suggested by the combination of references. See Spec. p. 9 Section E.

The Office Action posits that Bhardwaj teaches that etch parameter can be varied to change the etch rate. The Office Action further argues that one skilled in the art could optimize the result depend variable to achieve claim 4.

However, no reference teaches the problem of the claim 1 and dependent claims (4) solves, the bowed opening sidewalls. See spec. p 1., line 17; spec p. 4, lines 21 -24.p. 8, Lines 23 -26. Furthermore, no reference suggests the result dependent variables. Therefore

there is no way for one skilled in the art achieve claim 1 from the over thousand different combination possible from Ye 516. There is no motivation of achieve claim 1 because no reference attempts to solve the applicant's problem of bowing via sidewalls. See spec. p 1., line 17; spec p. 4, lines 21 -24.p. 8, Lines 23 -26. Specifically, Claim 4 specifies a "medium plasma power" that is not suggested by the combination of references. See Spec. p. 9 Section E.

**Rejection of claim 7 Under 35 U.S.C. § 103(a)**

The rejection of claim 7 Under 35 U.S.C. § 103(a) is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the following remarks .

Claim 7 depends from non-obvious parent claims as discussed above.

**Rejection of claim 9 Under 35 U.S.C. § 103(a)**

The rejection of claim 9 Under 35 U.S.C. § 103(a) is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the following remarks .

Amended claim 9 is non-obvious for the reasons discussed above for their respective parent claims. Moreover, claim 9 claim the exact process that create straight walled openings.

**Rejection of claims 19, 22-24 and 25 under 35 U.S.C. § 103a as being unpatentable over Ye '529 and Ngo**

The rejection of claims 19, 22-24 and 25 under 35 U.S.C. § 103a as being unpatentable over Ye and Ngo is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the remarks.

Parent claim 19 step c1, claims an etch with only NH<sub>3</sub> and N<sub>2</sub> etch gasses.

Claim 19 reads:

19. A method of fabrication of etching a low -k dielectric layer; comprising the steps of:
  - a) forming an organic low k dielectric layer over a insulation layer over a substrate;

- b) forming a masking pattern over said organic low k dielectric layer; said masking pattern having an opening;  
c) using an etch process **to etch** said organic low k dielectric layer through said opening to form a first opening using said masking pattern as an etch mask; said etch process comprising:

- (1) in a first step, etching said organic low k dielectric layer by applying a plasma power and flowing **only NH<sub>3</sub> and N<sub>2</sub> etch gasses**.

**The combination of Ye et al. and Ngo et al. is improper.**

The combination of Ye et al. and Ngo et al. is improper for the purpose cited in the Office Action because neither reference suggests they be combined and this can be only done by hindsight.

The office action dated 12/27/02, page 10, posits that the motivation to combine Ye and Ngo “comes from Ngo (paragraph 6) and that one skilled in the art would have found it obvious to combine Ngo into Ye method to produce the claimed invention.” However, in the combination, Ngo is being used to show claim 19, step (c), a NH<sub>3</sub> and N<sub>2</sub> etch thru a low k layer.

In contrast to claim 19, Ngo, shows a “plasma treatment”, not “an etch”. A close reading of Ngo col. 4, lines 40-42, shows that Ngo does not teach a etch step (of NH<sub>3</sub> and N<sub>2</sub>) but in contrast teaches a “plasma treatment”. See abstract. See col. 5, line 25, line 36- 48. See figs 1, 2 and 3. Ngo uses an unspecified chemistry to etch an opening. See Ngo, col. 5, lines 36 to 48.

The office action dated 12/27/02, page 6, posits that Ngo and Ye be combined because Ngo’s treatment improves the quality of the low-k, citing Ngo col. 4, L 43-47

It was found that treatment of an organic carbon-containing low-k ILD in accordance with embodiments of the present invention employing a plasma comprising nitrogen and a source of hydrogen, e.g., a NH<sub>3</sub>/N<sub>2</sub> plasma, substantially prevents or significantly reduces degradation, such that the dielectric constant, shrinkage and refractive index do not undergo a change in excess of 3%. It was also found that treatment of dielectric materials, such as SiCOH, with the NH<sub>3</sub>/N<sub>2</sub> plasma substantially prevented a reduction in the number of Si-H bonds during subsequent processing.  
Ngo col. 4, L 40-49.

However, claim 19 step c is an etch step to form an opening. The Ngo’s plasma treatment to reduce low-k shrinkage is not an etch, nor does Ngo suggest that his plasma treatment can be used as an etch.

**Even if combined Ye and Ngo do not meet claim 19, step c.**

Even if combined Ye and Ngo do not meet claim 19 step c1. Yu col. 22, lines 39 to 42 teaches a  $\text{NH}_3$  only etch. This teaches away from claim 19's only  $\text{NH}_3$  and  $\text{N}_2$  etch gasses.

In contrast to amended claim 19's "etch process to etch said organic low k dielectric layer through said opening to form a first opening using said masking pattern as an etch mask; Ngo col. 4, lines 40-42 does not form a first opening. In contrast, Ngo only performs a "plasma treatment" See col. 4, lines 40 to 49; See col. 4, lines 5 -20. Ngo is a different step, previous step, forms an opening. See Ngo col. 5, lines 37 – 40.

Therefore, it is improper to cite Ngo as an etch step. Furthermore, Ngo does not met or suggest claim 19's etch step or chemistry.

**Claims 22-24 and 25**

Claims 22-24 and 25 depend from non-obvious parent claim 19 are therefore non-obvious.

**Rejection of claims 20-21 under 35 U.S.C. § 103 as being unpatentable over Ye '529 and Ngo and Bhardwaj**

The rejection of claims 20-21 is acknowledged. Claim 20 depends from non-obvious parent claim 19 as discussed above. Claim 20 claims non-obvious parameters. Claim 21 contains non-obvious parameters.

Claims 20-21 state:

20. (Amended) The method of claim 19 wherein said first step comprises:  
power in between 500 and 1500 W, plasma power plasma density between  $1\text{E}9$  and  $1\text{E}11 \text{ cm}^{-3}$ , a  $\text{NH}_3$  flow between 50 and 300 sccm and a  $\text{N}_2$  flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr.

21. (Amended) The method of claim 19 wherein said first step comprises:  
power in between 500 and 1500 W, plasma power plasma density between  $1\text{E}9$  and  $1\text{E}11 \text{ cm}^{-3}$ , a  $\text{NH}_3$  flow between 50 and 300 sccm and a  $\text{N}_2$  flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing CO or  $\text{O}_2$  gasses.

**Combination of Ye and Bhardwaj is improper.**

The combination of Ye and Bhardwaj is improper. The combination of Ye and Bhardwai can only be done by hindsight. There is no suggestion to combine the references. The references teach incompatible processes and teach away from each other. The point Bhardwai is cited for, increasing the etch rate by varying every process parameter, is not related to the invention's object to increase the etch rate and straightness of the vertical walls of the opening. See spec. p. 12 lines 12 and claim 9.

Therefore, claims 20-21 are non-obvious.

**Rejection of claim 26 under 35 U.S.C. § 103 as being unpatentable over Ye '529 and Ngo and McReynolds**

Rejection of claim 26 is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the comments.

Claim 26 depends from a non-obvious parent claim and is non-obvious.

Furthermore, the combination of reference is improper because there is no motivation to combine them and they can only be combined by hindsight. Moreover, McReynolds teaches a total unrelated etch process of different material, different gases and different results.

**Rejection of claims 27 -29 under 35 U.S.C. § 103 as being unpatentable over Ye '529 and Ngo and Ye**

The rejection of claims 27 -29 under 35 U.S.C. § 103 is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the comments.

Parent claim 27 contains the limitations of parent claim 19 and is non-obvious for the reasons stated above.

Dependent claims 27 and 28 depend from non-obvious parent claim 27 and are therefore non-obvious. Claims 27 and 28 claim and etch with flowing NH<sub>3</sub> and N<sub>2</sub> etch gasses and flowing CO or O<sub>2</sub> gasses. These are non-obvious for the reasons stated above.

**ALLOWABLE SUBJECT MATTER**

1 Applicant gratefully acknowledges the allowance of claims 11, and 13-18.

2  
3 **CONCLUSION**

4 In conclusion, reconsideration and withdrawal of the rejections are  
5 respectfully requested. Allowance of all claims is requested. Issuance of the application is  
6 requested.

7 It is requested that the Examiner telephone the undersigned attorney or  
8 George Saile at (845) 452-5863 should there be anyway that we could help to place this  
9 Application in condition for Allowance.

10 Respectfully submitted,

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